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STUDIES IN THE GENUS HEVEA I

BY

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1. THE DIFFERENTIATION OF HEVEA MICROPHYLLA AND H. MINOR

IN 1899, Hemsley described and illustrated an unusual species of *Hevea*, naming it *H. minor* because of its small stature. The species was based upon fruiting material collected by Richard Spruce on the Río Casiquiare in southern Venezuela.

A few years later, in 1905, Ule described *Hevea microphylla*, basing the species upon fruiting material which he had collected on the lower Rio Negro in Brazil. Five years later, the monographer Pax published variety *typica* and variety *major* of this concept.

In 1906, Huber (Bol. Mus. Goeldi 4 (1906) 633–634) suggested that *Hevea microphylla* might be synonymous with *H. minor*, pointing out several characters in which the two concepts, as described, agree. He admitted, however, that there seemed to be differences in other characters, so he chose "to consider *H. microphylla* a distinct species for the present." Identifying a flowering collection made by Ducke (*Ducke 7027*) in the lower Rio

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Negro as representing *Hevea minor*, Huber published an amplified description of this species, which included a description of the flowers of the Ducke specimens (loc. cit. 634–635). He indicated that the two species appeared to be closely allied, although the flowers of *Hevea microphylla* were not known. In 1913, Huber still maintained them as distinct concepts, including them with *Hevea brasiliensis* (HBK.) Muell.-Arg. in his series *Intermediae* as he had done previously (loc. cit. 622), but intimating that further studies might make it necessary to remove *H. microphylla* and *H. minor* from series *Intermediae* (he considered series *Luteae* and *Intermediae* to represent provisional classifications and not natural groups) and, together with *H. rigidifolia* (Spruce ex Bentham) Muell.-Arg., to form a new group (Bol. Mus. Goeldi 7 (1913) 202).

Apparently accepting Huber's determination of his flowering collection (*Ducke 7027*) as *Hevea minor*, Ducke, who had collected topotype material of *H. microphylla* (*Ducke HJBR 23750*) which agreed in all characters with *Ducke 7027*, reduced *H. microphylla* and *H. microphylla* var. *major* to synonymy under *H. minor* (Arch. Instit. Biol. Veget. 2, no. 2 (1935) 242). Recently, he has maintained this opinion (Bol. Tecn. Instit. Agron. Norte no. 10 (1946) 20). Baldwin enumerated nine species which he accepts as valid: he includes *Hevea minor* but makes no mention of *H. microphylla*, thereby suggesting agreement with Ducke's treatment of the latter as representing the same concept as the former (Journ. Hered. 38, no. 2 (1947) 54.

While engaged in a study of *Hevea* in the Kew Herbarium in June, 1947, I was able to consult the type of *H. minor* (*Spruce 3457*) as well as a sterile duplicate type (*Ule 6025*) and a topotype (*Ule 6023*) of *H. microphylla*. It is now apparent that *Hevea minor* and *H. microphylla*

represent two distinct entities. It is also evident from a comparison of *Ducke 7027* and *Ducke HJBR 23750* with the type material that the two Ducke collections represent *H. microphylla.* This being so, the flowers which Huber described in his amplified description of *Hevea minor* (Bol. Mus. Goeldi 4 (1906) 634–635) are actually flowers of *H. microphylla. Hevea minor* is still known only from the type collection which is in fruit.

It is unfortunate that the misinterpretation of these two concepts has become so firmly established in *Hevea* literature. The following observations are presented with the hope that they may lead towards clarification.

The seed and capsule of the type of *Hevea minor* were very accurately illustrated by Hemsley in conjunction with his original description of the species (Hooker's Icon. Pl. (1899) t. 2572). Perfectly complanate-ovoid with two very conspicuous flat surfaces ventrally and a very pronounced ridge dorsally, the seed measures 15 mm. long, 9 mm. thick, 11–12 mm. wide. The valves of the capsule, which have an unusually thick ligneous endocarp—nearly 3 mm. thick—in relation to their overall size are only slightly contorted due to dehiscence; they measure 26 mm. long, 11 mm. deep. The epicarp of the capsule is apparently extremely thin in life. The capsule itself is perfectly globose with very little trace of a trisulcate condition, is not apically pointed, and measures about 25 mm. long and 25 mm. in diameter. It is borne on a slender peduncle about 4 cm. in length.

Similarly, an adequate description and a clear illustration of the critical structures of *Hevea microphylla* are available (Engler Bot. Jahrb. 35 (1905) 668, t. 1: k, l). The seed is rather large, measuring, according to the type description, 20–25 mm. long, 12–15 mm. thick, and would suggest, in many respects, the smaller seeds of *Hevea Spruceana* (Benth.) Muell.-Arg. It is peculiarly

obovoid, much wider at the base than at the apex, is subquadrangular in cross section, has obsolete flat surfaces ventrally and absolutely no ridge dorsally. The seeds which accompany the topotypical specimen *Ducke HJBR 23750*, which is, indeed, a very close match for *Ule 6023* and *6025*, are in complete agreement with those described by Ule and measure 25–28 mm. long, 15–16 mm. thick, 17–18 mm. wide at the widest point. The valves of *Ducke HJBR 23750* are large, measuring up to 45 mm. in length. They have an extraordinarily thin endocarp which is only 0.3 mm. thick! In dehiscence, they twist very tightly, due probably to the almost papery consistence of the endocarp. If we are to judge from Ule's figure, the capsule of *Hevea microphylla* is elongate-ovoid-pyramidal with a very acute apex, slightly trisulcate with a conspicuous dorsal keel in each carpel, 40–50 mm. long, 30–40 mm. in diameter. It is borne on a robust peduncle 6–7 cm. long.

There appear to be no significant distinguishing characters in the leaves of the two concepts except that the leaves of *Hevea minor* are definitely concolorous, whereas those of all collections of *H. microphylla* are very discolorous. Floral characters which might further separate them will not be available until *Hevea minor* is found in flower. I believe that the seeds of the two are so utterly distinct in size and shape that we are justified in regarding them as distinct species.

There are no valid reasons whatsoever for Pax's creation of *Hevea microphylla* var. *major*. Pax gives as his basis for the variety "foliola majora, angustiora," but *Ule 6023* and *6025* as well as *Ducke 7027* and *Ducke HJBR 23750* show all possible intergradations in the size of the leaflets, and this is known to be a character of little taxonomic value in *Hevea*. It is clear that the description of *Hevea microphylla* var. *major* is the de-

scription of an individual collection and does not represent a biological entity.

Were the confusion which has been created by the reduction of *Hevea microphylla* to synonymy under *H. minor* confined to nomenclature, it would probably not be so urgently in need of clarification. It has led to serious misunderstanding of the fundamental biology of the two plants.

When Hemsley described *Hevea minor*, his basic diagnosis was: "pro genere omnibus partibus parvis, seminibus albis immaculatis," and, following the description, he observed: "This is so very distinct in the smallness of all its parts, and particularly in its small white seeds, that we have not hesitated to establish it on incomplete material." Later, Pax emphasized this unusual condition of the seed when he wrote, under *Hevea minor:* ". . . . semina laevia, immaculata, triangulari-oblonga, alba. . . ." (Engler Pflanzenr. 4, 147 (1910) 125). Hemsley and Pax, both without field experience in *Hevea* studies, had not realized that the seeds which they were describing were white and without spots because they were unripe. Huber had pointed this out in 1906 (Bol. Mus. Goeldi 4 (1906) 633), explaining that he had noted in his own field work with *Hevea brasiliensis* and other species that unripe fruits can ripen and even open after separation from the tree, in which case the seeds do not develop normally. The fact that the seeds of the type specimen of *Hevea minor* were unripe was also stated by Ducke (Arch. Instit. Biol. Veget. 2, no. 2 (1935) 242). I have examined the seeds carefully and, basing my judgment on field experience in the collection and study of several tons of seed of *Hevea brasiliensis*, find that, while they were slightly short of complete maturation when Spruce collected the specimen, the hardness of their testa and their fully rounded out appearance are convincing evi-

dence that full size, or very nearly so, and mature shape had been obtained. These, after all, are the characters of fundamental significance; the type of coloration which the seed would have had when ripe is of much lesser importance.

It is necessary to consider the mode of dehiscence of *Hevea minor* and *H. microphylla* because great significance has been placed on this in the classification of the genus.

Ducke (Arch. Instit. Biol. Veget. 2, no. 2 (1935) 243) interpreted the fruit of *Hevea minor* as follows: "This species was created . . . . on a specimen . . . . without flowers and with no mature capsule (the seeds are still white!) but sufficiently characterized by the form of the leaves and chiefly by the form, the consistence and the slow dehiscence of the capsule (see the half-opened capsule reproduced in Hemsley's work, a feature which would be impossible in the case of any other known *Hevea* species)." In his key to the species of *Hevea*, Ducke (loc. cit. 225) says of *H. minor:* "Capsule . . . . opens with a slow dehiscence and lets the seeds fall in the water; the capsule then twists itself and remains for a long time adherent to the peduncle . . . ." He separates *Hevea minor* from all other species on the basis of the presumed slow dehiscence of the capsule of the former as against an explosive shedding of seed in the latter (loc. cit. 221). This erroneous stand results from the belief that *Hevea minor* and *H. microphylla* are one and the same.

Judging from the structure of the thick, woody valves of the capsule of *Hevea minor*, the capsule opens, as in all other species with comparably strong valves, more or less explosively. The valves are not strongly twisted, due to their shortness and their extremely strong ligneous endocarp which measures, as stated above, up to 3 mm.

in thickness. They may dehisce as in some specimens of *Hevea Spruceana* where the explosion is less violent than in most other species, but the structure of the valves indicates definitely that dehiscence is explosive. The "half-opened fruit" drawn by Hemsley's artist and actually preserved in that state on the herbarium sheet is due, I believe, to the fact that, as shown by the whiteness of the seeds, the capsule was not quite mature and that the artificial heat applied in making the dried specimen caused it to open partially while still under pressure in the plant press. This has often occurred when I have been drying *Hevea* specimens by means of artificial heat. Unless we can find some definite evidence of slow opening and gentle dropping of the seed in *Hevea minor*, we are making an unsound assumption in believing that such a mode of dehiscence is normal.

In *Hevea microphylla*, however, there is indeed very strong evidence that slow dehiscence is the rule, for the entire structure of the valves is distinct and is such that a violent opening and shedding of the seeds would be mechanically impossible. The valves are provided with an excessively thin—0.3 mm.—endocarp which is coriaceous, not even woody. Clearly, this structure is too weak to build up the tension necessary for a violent bursting. The valves open slowly, as Ducke has pointed out, and let the seeds drop slowly to the ground, persisting for some time on the peduncle (as often is the case in *Hevea Spruceana*) and then, when the seed is shed, twist themselves rather tightly due to their almost papery consistence. This is indeed unusual in the genus.

There would appear to be a strong ecological differentiation between *Hevea minor* and *H. microphylla*. The former is known only from the dry, sandy scrub-forest or caatinga of the Casiquiare. The latter, so far as available collections indicate, inhabits forests which are peri-

odically subject to very deep flooding. Spruce does not give us in his notes any indication of the shape of the trunk of *Hevea minor*, stating merely: "Arbor parva, 15 pedalis." If the trunk had deviated from a normal cylindrical shape, this careful observer would certainly have noted the fact. *Hevea microphylla* responds to its flood habitat by producing a swollen or bellied trunk, and it is called *seringa barriguda* (=bellied rubber) by the natives of São Joaquim on the Rio Negro, the same common name which is applied to *H. Spruceana* (Ducke: Bol. Tecn. Instit. Agron. Norte no. 10 (1946) 21).

Clavis specierum Heveae minoris et H. microphyllae:

A. Arbor parva 15 pedalis, cum trunco probabiliter cylindrico, in caatinga occurrens. Folia concoloria. Capsula perfecte globosa, 25 mm. × 25 mm., cum pedunculo subgracili, 40 mm. longo; valvis 26 mm. longis, vix contortis, endocarpio lignoso, usque ad 3 mm. crasso. Semina parva, complanato-ovoidea, 15 mm. × 9 mm. × 11–12 mm., carina dorsali conspicua. Dehiscentia probabiliter explodens.

1. *Hevea minor*

AA. Arbor parva vel mediocris, cum trunco infra incrassato, in sylvis profunde inundatis occurrens. Folia discoloria. Capsula ovoideo-pyramidalis, apice valde acuta, 40–50 mm. × 30–40 mm., cum pedunculo robusto, 60–70 mm. longo; valvis 45 mm. longis, valde contortis, endocarpio vix coriaceo, valde tenuissimo, 0.3 in diametro. Semina magna, elongato-obovoidea, subquadrangularia, 20–28 mm. × 12-16 mm. × 17–18 mm., ecarinata. Dehiscentia ut videtur lenta.

2. *Hevea microphylla*

1. Hevea minor *Hemsley* in Hooker's Icon. Pl. 26 (1899) tab. 2572; Pax in Engler's Pflanzenr. 4, 147 (1910) 125.

Venezuela: Río Casiquiare, "in sylvis humilioribus. Arbor parva, 15 pedalis. Siphonia." *Richard Spruce 3457* (Typus Herb. Kew). [In Spruce's field note-book, preserved at Kew, the following annotations appear: "3457. Siphonia – Casiq. Caatinga. Sm. tree 15 ft. Lts. sm. lanc. acum. obt. Frt."]

2. Hevea microphylla *Ule* in Engler's Bot. Jahrb. 35 (1905) 669, tab. 1: j, k, l, m; Ule in Kautschukgewinnung (Kolonialwirtsch. Kom. 1905) (1905) 10; Huber in Bol. Mus. Goeldi 4 (1906) 634 pro parte [non accurate, sub *Hevea minore*], 636; Pax in Engler's Pflanzenr. 4, 147 (1910) 125; Ducke in Arch. Instit. Biol. Veget. 2, no. 2 (1935) 241 pro parte, tab. pag. 246, a–f, 247, a–b [non accurate, sub *Hevea minore*]; Ducke in Bol. Técn. Instit. Agron. Norte, no. 10 (1946) 20 pro parte.

Hevea microphylla *Ule* var. typica *Pax* in Engler's Pflanzenr. 4, 147 (1910) 126.

Hevea microphylla *Ule* var. major *Pax* in Engler's Pflanzenr. 4, 127 (1910) 126.

Brazil: Estado do Amazonas—Rio Negro. "Inseln Xiparú, São Joaquim. [Nom. vulg. =] *seringa serapó*. *E. Ule 6023*, February 1902 (Herb. Kew).—"Inseln Xiparú, São Joaquim. [Nom. vulg. =] *carriguda*. *E. Ule 6024*, February 1902 (Typus *Heveae microphyllae* var. *majoris* non vidi).—"Inseln Xiparú, São Joaquim. [Nom vulg. =] *tambaqui seringa*." *E. Ule 6025*. February 1902. (Typus duplicatus Herb. Kew).—"Barcellos." *A. Ducke 7027*.—"Insula Xiparú, prope São Joaquim . . . . silva profunde inundata. Arbores (3 ex.) parvae vel mediocres, trunco infra incrassato, flor pallide luteis. [Nom vulg. =] *seringa tambaqui* vel *seringa barriguda*." *A. Ducke Herb. Jard. Bot. Rio 23750*, August 8, 1931 (Topotypus Herb. Kew; U.S. Nat. Herb.).

2. A NEW INTERPRETATION OF HEVEA NITIDA AND ITS VARIETY

Hevea nitida *Martius ex Mueller-Argoviensis* in Martius Fl. Bras. 11, pt. 2 (1874) 301.

Siphonia nitida Martius ex Mueller-Argoviensis loc. cit.

Hevea viridis Huber in Bull. Soc. Bot. France 49 (1902) 48; emend. in Bol. Mus. Goeldi 7 (1910) 235.

In his forthcoming "A Study of Hevea with its economic aspects in the Republic of Peru," Dr. Russell J. Seibert reduces *Hevea viridis* to synonymy under *H. nitida* on the basis of new characters which he has found

to be of great value in the classification of the species of this genus.

Hitherto, (in Bot. Mus. Leafl. Harvard Univ. 12 (1945) 7) I have believed *Hevea nitida* to represent the concept which Ducke described as *H. brasiliensis* (HBK.) Muell.-Arg. var. *subconcolor*. I am now, however, in complete agreement with Seibert's point of view that *Hevea nitida* is a distinct concept representing the same species as that which has been known as *H. viridis*.

Seibert writes: "They [certain specimens of *Hevea viridis*] appear to represent topotypical cultivated material from Huber's type locality of *H. viridis*. The one flowering collection made by Archer is quite referable to *H. nitida* in floral morphology, the short-shoots, and in general, the leaflets. The lower leaf surfaces of this and other specimens of the cultivated plant, however, tend to show a minute lepidote condition slightly atypical of *H. nitida*. The scales, notwithstanding, are neither of sufficient size nor density to affect the concolorous aspect. There remains some question, since the leaflets do show a slight *H. brasiliensis* aspect, whether or not Huber's *H. viridis* had some admixture of *H. brasiliensis* germ-plasm.

"Through the excellent photograph (made by the Chicago Field Museum) of the entire type specimen of Martius' collection deposited in the Herbarium at Munich, it has been possible to identify *H. nitida* with *H. viridis* with some degree of certainty. The presence of interflush short-shoots as well as the glossy under surface of the leaflets leaves little doubt that *H. viridis* should henceforth be referred to *H. nitida*."

In view of this new understanding of *Hevea nitida*, it is necessary to alter the name of the diminutive, shrubby *Hevea*, described as *H. viridis* var. *toxicodendroides*

from the ancient remnant quarzite hills of the Apaporis-Vaupés area of Colombia.

Hevea nitida *Martius ex Mueller-Argoviensis* var. **toxicodendroides** (*R. E. Schultes et Vinton*) *R. E. Schultes comb. nov.*

Hevea viridis Huber var. *toxicodendroides* R. E. Schultes et Vinton in Caldasia 3 (1944) 25.

"*Hevea toxicodendroides* R. E. Schultes ex P. H. Allen in Mo. Bot. Gard. Bull. 32 (February, 1944) 50; *nomen nudum.*

AN ERRONEOUS RECORD OF HEVEA IN COLOMBIA

BY

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In Rees' "Cyclopedia" (39 (1819) sub *Siphonia*), there is a most interesting reference to a Mutis collection of *Hevea guianensis* Aubl. ("*Siphonia elastica*") from Colombia. Sir J. E. Smith, who compiled the section of the encyclopedia on *Siphonia*,[3] wrote: "There is, indeed, in the Linnaean herbarium, besides the original specimen,[4] marked with this last name [*Siphonia elastica*], another from Mutis, which that learned botanist judged to be a distinct species, though affording, as some other trees do, a similar gum. The leaflets in this specimen are larger, more acute at each end, and destitute of partial stalks. The calyx is nearly half an inch long. The

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[3] Lady Smith: "Memoir and correspondence of the late Sir James Edward Smith, M.D." 1 (1832) 488–489; B. D. Jackson: "An attempt to ascertain the actual dates of publication of the various parts of Rees' Cyclopedia" (1895) 8.

[4] This statement undoubtedly refers to a specimen of *Hevea guianensis* preserved in the Linnaean Society in Smith's herbarium. From all appearances of the specimen, it is one of the Aublet collection from French Guiana and represents the type of the genus.

younger Linnaeus, in his *Supplementum* 422, promised to publish something at a future time respecting the various trees that yield an elastic gum of the same utility as the *Caoutchouc;* but he did not live to execute his design."

From the point of view of the taxonomic history of *Hevea*, the genus of the Pará rubber tree, the existence of a Mutis specimen would be of the utmost significance.

It would represent the earliest known collection of the genus from Colombia, the northwesternmost sector of its range. A Mutis specimen would also be of extreme importance as it would alter our understanding of the distribution of *Hevea*, for, so far as we are aware, no Mutis material was collected in those parts of the Amazon and Orinoco drainage areas where the genus is known to occur.

For these reasons, we consulted the Mutis material to which Smith made reference and which is preserved in Linnaeus' herbarium at the Linnaean Society. The specimen, included in the *Jatropha* folder, is not a *Hevea* but represents the rutaceous *Cusparia trifoliata* (Willd.) Engler,[5] the type of which was collected in Venezuela.

Comprising several leaves and an inflorescence of fertilized flowers from which the corollas have dropped, the specimen is mounted upon paper bearing a Spanish watermark. In the upper right corner of the sheet, there is, in Mutis' handwriting, a figure "89." At the bottom of the sheet, the elder Linnaeus had written "Hevea" on one line and "elastica" below it, an epithet which has never been published. The younger Linnaeus scratched out the word "Hevea" and substituted "Jatropha," but he did not cite the collection in his *Supplementum 422* under *Jatropha elastica* to which concept he reduced

[5] Tabula in Humboldt. Plant. Aequin. 2 (1813) t. 97.

Aublet's *Hevea guianensis.* Elsewhere on the sheet, apparently in the elder Linnaeus' hand, there is an annotation "Gummi elastique."

A detailed search through the collection of Mutis' correspondence with Linnaeus, preserved at the Linnaean Society, revealed an enumeration of two shipments of plants from Colombia to Sweden. The specimen in question was included in the second shipment. We find that Mutis had made, under "89" in the enumeration of the specimens of this shipment, the following interesting annotation: "Pro Chinchona habita ab incolis guyanae." Even though the term *guyana* was rather loosely employed in this early period to designate much of southern Venezuela and the Orinoco basin, it has been impossible for us to ascertain Mutis' source for this statement. It is, of course, highly significant as an observation, because *Cusparia trifoliata* is the source of Angostura-bitters and has been used rather widely in South American folk-medicine as a febrifuge. Humboldt states that "On the coasts of New Andalusia, the cuspa is considered as a kind of Cinchona." [6]

Further study of Mutis' correspondence has failed to shed any light on Linnaeus' source for his annotation "Gummi elastique." It is most probable, in our opinion, that the note was added somewhat casually for the benefit of students after the plant had been determined, to Linnaeus' apparent satisfaction, as representing the concept now known as *Hevea guianensis. Cusparia trifoliata,* of course, is not a latex-bearing plant.

There is an additional annotation on the sheet. It is in pencil, apparently in the handwriting of Smith, and states that the specimen is markedly different from a sterile specimen from Brazil which Linnaeus had likewise

[6] Personal Narrative (translated by H. M. Williams) 3 (1822) 27.

annotated "Gummi elastique" but which had not been labelled with a Latin epithet. This Brazilian specimen[7] is neither *Jatropha* nor *Hevea* but, curiously, would seem also to be a rutaceous plant, *Esenbeckia febrifuga* (St. Hil.) Mart., likewise a source of bitters and often, in an earlier period, used to adulterate or falsify true Angostura-bitters. It naturally does not represent a lacticiferous plant, and the annotation with reference to gum elastic is as erroneous as the analogous annotation on the sheet of the Mutis specimen of *Cusparia trifoliata* and was undoubtedly made for the same purpose.

We wish to express our appreciation to Spencer Savage, Esq., Assistant Secretary of the Linnaean Society, for his very kind help in the study which has led to the clarification of the erroneous record of a Mutis collection of *Hevea*.

[7] The Brazilian specimens in the herbarium of Linnaeus were probably collected by Joaquim Velloso de Miranda (1733–1815) and sent to Linnaeus by Domenico Vandelli (1735–1816). He collected in Minas Geraes.